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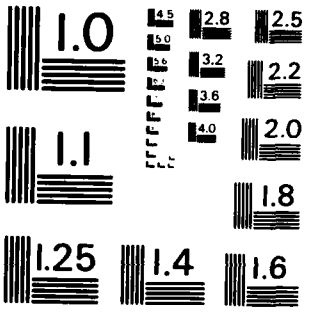

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18. SUPPLEMENTARY NOTES

Dr. Findler has moved to the Computer Science Department, Arizona State University, Tempe AZ 85287.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

(1) Generalized Production Rules; expert systems; numerical estimation of hidden variable values; distributed intelligence. (2) Automatic generation of descriptive and normative theories; asymptotic form of a sequence of decision trees; credit assignment to strategy components; self-optimizing statistical design generator; quasi-optimum strategies. (3) Advice taker/inquirer system; (CONT.)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The efforts of the research group for Computer Studies of Strategies centered on three long-term projects: (1) The Generalized Production Rules System (GPRS) is a program which can support decision-making for a variety of expert systems in need of estimates of hidden variables. Hidden variables are such that their values can be identified only at certain times, either intermittently or periodically. In contrast, open variables are readily measureable at any time. The estimation is based on stochastic, causal relations between hidden and open variables. (CONT.)

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ITEM #19, CONT.: acquisition of strategies via principles and high-level examples; experientialization; trainee evaluation automated.

ITEM #20, CONT.: (2) The Quasi-Optimizer System (QO) is a program which observes and measures adversaries' behavior in confrontations, infers their strategies, and constructs a descriptive theory, i.e., a model of each. It then identifies the components of the strategies, evaluates their effectiveness and combines the most satisfactory ones into a normative theory which is an optimum strategy in the statistical sense.

(3) The Advice Taker/Inquirer System (AT/I) is a program which can be taught strategies by a human advisor. The advisor provides principles and high-level examples of actions in different situations. The system applies the strategy to test, verify and optimize the strategy.

The following describes the essential accomplishments made in Phase I, that is during the period of the first grant support, July 1, 1981 - August 30, 1982. The Group for Computer Studies of Strategies has now moved from the State University of New York at Buffalo to Arizona State University and continues its work on Phase II.

(1) The Generalized Production Rules System (GPRS)

We have completed the following main modules:

(1.1) GPR-1, which fits a minimal set of basic patterns, morphs, to a sequence of datapoints so that the amount of unexplained variance is below a prespecified level.

(1.2) GPR-2, which establishes stochastic and, assumedly, causal relations between sets of parametric values of morphs, describing open variable behavior, and individual values of hidden variables.

(1.3) GPR-3, which combines rules that connect identical open and hidden variables while satisfying certain similarity and rule generation criteria.

(1.4) GPR-4, which provides a specified number of best estimates of hidden variables at desired time (or space) points.

(1.5) GPR-5, which extends the system to distributed intelligence and processing. If certain statistical and file-generation criteria are satisfied -- as verified by the system automatically -- it merges source files and knowledge bases established, for example, at different observation points

by satellite computers.

(1.6) GPB-6, which provides a functional, rather than point, estimate of the hidden variables.

* * *

(2) The Quasi-Optimizer System (QO)

We have completed the following main modules:

(2.1) QO-1, which assumes a monotonic strategy response surface and uses either exhaustive search or binary chopping to construct a descriptive theory of static (non-learning) strategies.

(2.2) QO-2, which extrapolates a finite sequence of decision trees, each representing the same learning strategy at different stages of development, and computes their asymptotic form if certain statistical criteria are satisfied. The asymptotic form will then be used in the construction of a normative theory.

(2.3) QO-3, which minimizes the total number of experiments QO-1 has to perform. It no longer assumes that the strategy response surface is monotonic. QO-3 starts with a balanced incomplete block design for experiments and computes dynamically the specifications for each subsequent experiment.

(2.4) QO-4 performs the credit assignment. It identifies separable components of a strategy and assigns to each a quality measure of the 'outcomes'. The latter need not be only the immediate result of a sequence of actions prescribed by the strategy but can also involve long-range consequences of planned actions.

* * *

(3) The Advice Taker/Inquirer AI/I System:

We have completed the following modules:

(3.1) AI/I-1, which does lexical analysis of the user's input stream.

(3.2) AI/I-2, which is a general purpose parser for user input.

(3.3) AI/I-3, which is a high-level editor for user input.

PUBLISHED WORK

(A) On GPBS-related research:

(1) Nicholas V. Findler: Pattern recognition and generalized production systems in strategy development (Proc. Fifth Internat. Conf. on Pattern Rec., Vol. I, pp. 140-145).

(2) Nicholas V. Findler: A multi-level technique using production systems (Cybernetics and Systems, 13, pp. 25-30, 1982).

(3) Nicholas V. Findler and Ernesto Morgado: Morph-fitting -- An effective technique of approximation (Accepted by the IEEE Trans. on Pattern Analysis and Machine Intelligence).

(4) Nicholas V. Findler: An expert subsystem based on generalized production rules (Accepted by the Hawaii Internat. Conf. on Systems Sciences-16, 1983).

(5) Nicholas V. Findler, John E. Brown, Ron Lo, and Han Y. You: A module to estimate numerical values of hidden variables

for expert systems (Accepted by the Internat. Journal for Man-Machine Systems).

(6) Nicholas V. Findler and Ron Lo: A note on the functional estimation of values of hidden variables -- An extended module for expert systems (Accepted by the Internat. Journal for Man-Machine Systems).

(B) On QQ-related research:

(7) Nicholas V. Findler and Jan van Leeuwen: The complexity of decision trees, the Quasi-Optimizer, and the power of heuristic rules (Information and Control, 40, pp. 1-19, 1979).

(8) Nicholas V. Findler and João P. Martins: On automating computer model construction -- The second step toward a Quasi-Optimizer system (Journal of Info. and Optimization Sciences, 2, pp. 119-136, 1981).

(9) Nicholas V. Findler, Neal Mazur and Bede McCall: A note on computing the asymptotic form of a limited sequence of decision trees (Submitted for publication).

(10) Nicholas V. Findler: A preliminary report on a self-optimizing experimental design-generator (Proc. COMSTAT82, The Fifth Internat. Symp. on Computational Statistics. Physica-Verlag: Würzburg, West Germany, 1982).

(11) Nicholas V. Findler: An overview of the Quasi-Optimizer system (Submitted for publication).

(C) On AI/I-related research

(12) Nicholas V. Findler, George L. Sicherman and Steven Feuerstein: Teaching strategies to an Advice Taker/Inquirer system (Proc. Euro IFIP79 Conf., London, England, pp. 457-465, 1979).

(13) George L. Sicherman: The Advice Taker/Inquirer (Doctoral Dissertation Proposal and Group for Computer Studies of Strategies Technical Report No. 5, 1981).

(D) On other projects:

(14) Nicholas V. Findler: Aspects of computer learning (Cybernetics and Systems, 11, pp. 65-84, 1980. Also reprinted in R. Trappl, N. V. Findler and W. Horn (Eds.): Progress in Cybernetics and Systems Research, Vol. 11, Hemisphere Publishing: Washington, DC, 1982).

(15) Nicholas V. Findler: Analogical reasoning in design processes (Design Studies, 2, pp. 45-51, 1981).

(16) Nicholas V. Findler: A simple 'Teachable Automatic Program Generating System' written as a term project in an introductory course on Artificial Intelligence (Proc. Third World Conf. on Comp. Education, Lausanne, Switzerland, pp. 725-729, 1981).

(17) Nicholas V. Findler and Anthony Ralston: Theory or Practice? Concerns of Computer Science education in a developing country (Invited paper for the First Internat. Info. Conf. in Egypt; Cairo, Egypt, 1982).

(18) Nicholas V. Findler: Towards a theory of strategies (Submitted for publication).

(19) Nicholas V. Findler: Automatic analysis and synthesis of strategies: A new branch of Artificial Intelligence (Accepted by the Second Annual Pheonix Conf. on Computers and Communications, 1983).

(20) Nicholas V. Findler, George L. Sicherman, and Bede McCall: A multi-strategy gaming environment (In M. Bramer (Ed.): Game-Playing Programs: Theory and Practice, Ellis Horwood: Chichester, England, 1982).

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